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DECORATIVE COMPOSITE MATERIALS AND
FUNCTIONAL ELEMENTS CONSTRUCTED THEREFROM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to decorative composite materials that may be used in flooring, surface ornamentation, and other decorative applications.

2. State of the Art

There are several existing types of surface decoration materials. These include resilient materials, wood, tiles, stone, and concrete. Each of these materials has its unique advantages, but all suffer from significant disadvantages, such that none represents an ideal surface decoration material.

Resilient materials include vinyl tiles and sheets based on polyvinylchloride (PVC) chemistries; vinyl composition (e.g., asphalt) tiles and sheets that includes various fillers that decrease the amount of polyvinylchloride used; rubber tiles and sheets made from synthetic rubber; cork tiles made from granulated pieces of bark from the cork oak tree bonded together in combination with a binder/adhesive using heat and pressure; vinyl-faced cork tiles made from cork and thermoplastic binders and laminated with a layer of polyvinylchloride; and linoleum tiles and sheets, which are a composition of oxidized linseed oil (or other binders), pigments, and fillers which are applied over a backing.

These resilient materials may be manufactured in a wide variety of colors and patterns, are easy to install, and are relatively economical. However, a major drawback is that, when used as flooring materials, they do not wear well, particularly in high-traffic areas. Further, they are easily susceptible to damage from scuffs, indentation from high-heeled shoes or hard objects dropped on the flooring, or staining, due to its porosity. Cork flooring is particularly susceptible to such types of damage. In addition, regular maintenance of the

flooring is required. In addition to washing, most resilient flooring needs to be waxed and polished in order to maintain its attractiveness and periodic stripping of built-up wax is necessary.

In particular, vinyl flooring exhibits varying resistant to stains and burns, and varying resilience. Vinyl composition flooring exhibits low resistance to burns and abrasion, low resilience and flexibility, and can be noisy. In particular, asphalt tiles exhibit a low resistance to alkalis, burns, grease, and oil, in addition to having low resilience and flexibility, and noisiness. Rubber flooring exhibits low resistance to greases and oils. Cork flooring has low resistance to alkalis and stains, low resistance to moisture, easily fades, and does not well bear heavy loads or concentrated foot traffic. Linoleum exhibits low resistance to indentations, burns, and alkalis, and tends to be noisy.

Wood is another widely used decorative surface material. Typically, oak, maple, beech, birch, bamboo, and other decorative woods are used for this purpose. Wood flooring can be laid in thin strips, typically in 1 1/2 inch to 2 1/4 inch widths, with varying lengths and joined by tongue and groove or beveled edges; planks, typically in 3 1/4 inch to 8 inch widths, again with varying lengths and joined by tongue and groove or beveled edges; pre-assembled blocks, which may comprise unit blocks held together with wood or steel splines, laminated block requiring 3 to 5 plies of cross-laminated wood veneer, parquet, which is pre-assembled in sections of several thin, small slats of wood creating patterns; or solid block flooring, made of solid (wood) end-grain blocks ranging from 2 inches to 4 inches in thickness.

Wood flooring may also be manufactured in a wide variety of colors and patterns. However, it is more difficult and expensive to install and maintain. Although it wears better than resilient flooring, particularly in high-traffic areas, it too is susceptible to damage from scuffs, indentation from high-heeled shoes or hard objects dropped on the flooring, or staining, due to its porosity. Unlike resilient flooring, wood flooring is a natural material that expands and contracts with changes in temperature and humidity. If not installed properly, wood flooring can

buckle (tenting). Tenting can also occur as the result of water damage. In addition, wood flooring can crack due to dryness. Regular maintenance of wood flooring is also required, including washing, waxing and polishing in order to maintain its attractiveness and periodic stripping of built-up wax. While use of a polyurethane coating reduces the damage caused by wear and otherwise, and reduces the need for waxing, this coating must also periodically be stripped and reapplied, which process is more involved and more expensive than with waxed floors.

Tile is also a relatively versatile decorative material. There are several different types of tile, including impervious, non-vitreous, semi-vitreous, and vitreous. Tiles can be ceramic, made from wet-formed clay, clay mixture, or other ceramic materials and then fired to the desired hardness; quarry tiles, made from natural clay or shale and formed by extrusion; or paver tiles, made from relatively dry clay shaped into tiles with dust pressed method.

Although tiles exhibit perhaps the widest variation in possible decorative effect, they significantly reflect sound and tend to be cold. Also, the tile glazing can crack allowing dirt to collect in cracks and discolor, and ceramic tiles are highly susceptible to breakage, water damage due to moisture. Finally, the grouting constantly gets dirty and cracks, requiring cleaning and periodic re-grouting. In addition, when used as flooring, ceramic tile tends to wear, losing their pattern, and heavy traffic can cause uneven wear and cupping. Quarry tiles also exhibit pattern wearing and have the same grouting problems as ceramic tiles. Paver tiles also tend to wear, resulting in the loss of their decorative pattern.

Another common surfaced decoration material is stone. A variety of stone materials are typically used, including granite, which is an igneous rock with embedded grains; limestone, including travertine, which has holes that are filled with resin when used as a flooring material; marble, which is a metamorphic rock formed from layers of shells, under heat coupled with pressure, into a composition consisting of crystalline grains of calcite and dolomite; sandstone, which is a sedimentary rock containing sand with other substances; and slate, which is a metamorphic rock with fine grains that tends to easily form flat sheets.

Although imparting significant natural beauty, stone can be the most expensive surface decoration material. In addition, it is cold to the touch, greatly reflects sound, can crack, and the grout used to install it gets dirty and cracks, requiring regular maintenance. Further, because it is a natural material, stone is available in different grades. Some stone has flaws, voids, and veins which need repair and which lessen the decorative effect. Perhaps most significantly, it is very difficult to obtain stone that exactly meets the decorative requirements of the designer and nearly impossible to match any replacement stone that may be required years after the installation, even if obtained from the original quarry.

Other materials used for surface decoration include concrete, bricks made of concrete or clay, and leather tiles made from tanned hides of animals, primarily cattle and swine. Concrete, although economical and easy to shape, holds moisture for several weeks after installation, tends to crack, is cold to the touch, often makes the room seem damp, and has limited decorative effect. Bricks tend to wear when used as a flooring material; are very difficult to obtain a flat, easily maintained surface; and are installed using mortar, which is more difficult and expensive to maintain than tile grout. Leather tiles tend to crack if not regularly oiled, easily stain, and can curl at the edges due to adhesive failure in response to changes in temperature and humidity.

Even resin tiles have been used. For example, Jap. Pub. No. 62271713A teaches a resin tile encasing a decorative metallic film. However, known resins vary widely in their stability and suitability for many surfaces.

What is needed are decorative materials that are highly resistant to wear and damage; consistently look clean; are relatively easy and economical to manufacture, install, and maintain; are attractive and provide a wide variety of decorative effects; and that appeal to a broad audience.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide decorative materials that are highly resistant to wear and damage.

It is another object of the present invention to provide decorative materials that are relatively easy and economical to manufacture, install, and maintain.

It is an additional object of the present invention to provide decorative materials that are attractive and provide a wide variety of decorative effects.

The present invention comprises decorative composite materials in the form of tiles, trays, light boxes, furniture, surfaces, partition walls, dividing screens, doors, and the like. These materials comprise a combination of elements embedded and/or encapsulated in an epoxy resin mixture that preferably allows the embedded and/or encapsulated elements to appear as if they are suspended or floating in space.

The materials provide superior flexibility of design element selection. They are easily installed using adhesives and can easily be cleaned with either a dry or damp mop or cloth, preferably with a biodegradable cleaner. Items, particularly tiles and other planar items, made from the materials may easily be refaced and refinished by lightly sanding and filling with epoxy.

Items made with the materials of the present invention may be highly decorative, are extremely durable, and may easily be made according to custom specifications. In addition, the finished tiles are solvent-free. They are waterproof; experience no shrinkage, contraction, or expansion; and are highly resistant to physical or chemical degradation. Specifically, they are resistant to mild mineral acids, alkalis, detergents, solvents, skydrol, hydraulic fluids, lubricating oils, salts, and the like.

Different design possibilities contemplated include tiles with encapsulated netting, photographs or other image media, and or combinations thereof; embedded or encapsulated gravel, sand, mica flakes, wood chips, fibers, textiles, and other natural and or manufactured items or materials. These elements may be arranged in any desired fashion, including random dispersal, stripes, swirls, geometric patterns, and the like.

Items contemplated by the present invention include dividing screens; room partitions; partition walls (with or without wheels or other means for movement); doors; indoor and outdoor furniture, including tables, tabletops, desks, chairs, chair backs; surfaces, including countertops, shelves, steps, walls and the like; light boxes; trays; and other such decorative structural and functional items.

Additional objects and advantages of the invention will become apparent to those skilled in the art upon reference to the detailed description taken in conjunction with the provided figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 A-C show a perspective view of the three steps of manufacture of an embodiment of a decorative tile according to the invention.

FIGS. 2 A-C show a perspective view of the three steps of manufacture of a second embodiment of a decorative tile according to the invention.

FIGS. 3 A-C show a perspective view of the steps of manufacture of a third embodiment of a decorative tile according to the invention.

FIGS. 4 A-C show a perspective view of the steps of manufacture of a fourth embodiment of a decorative tile according to the invention.

FIGS. 5 A-C show a perspective view of the steps of manufacture of a fifth embodiment of a decorative tile according to the invention.

FIGS. 6 A-C show a perspective view of the steps of manufacture of an embodiment of a decorative tile according to the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Decorative objects of the present invention are preferably made from a two-stage material comprising a base portion and a reactor (hardener) portion, which form a curable resin. Table 1 sets forth a preferred two-stage material for the resin.

Table 1.			
	CAS#	Preferred Weight% Range	Most Preferred Weight%
Base Portion			
Polymer of Epichlorohydrin and Bisphenol A	020585-99-8	75-93	82
Alkyl Glycidal Ether	0686609-97-2	7-25	18
Perox Violet 3B		0-0.0002	0
Reactor Portion			
Aromatic Alcohol	68155-17-9	15-35	30
Benzoic Acid, 2 Hydroxy (Salicylic Acid)	69-72-7	3-10	7
Cycloaliphatic Diamine	2855-13-2	35-65	51
Phenol-Nonyl	108-9-2	4-15	11
Polymer of Epichlorohydrin and Bisphenol A	020585-99-8	0.5-2	1
Trimethylhexaminediamine	25620-58-0	0-5	0
Perox Violet 3B		0-0.0002	0.0001

The constituents of the preferred base are mixed for about 30 minutes at room temperature (about 55°F to about 85°F) with a low-speed agitator. Aromatic alcohol and/or phenol-nonyl may be substituted for up to 5% of the alkyl glycidal ether of the base, provided the alkyl glycidal ether preferably remains at or above approximately 13%.

The constituents of the reactor portion are also mixed together. In the reactor, the cycloaliphatic diamine is the main hardener and provides a blush free and non-sticky hardened resin which has no exudations. The benzoic acid, 2 hydroxy (salicylic acid) and the polymer of epichlorohydrin and bisphenol A function as accelerators. The trimethylhexaminediamine is an optional constituent. The Perox Violet 3B is an optional clearing agent, available in powder form from Pylam Products Company, Inc. of Tempe, Arizona, USA, which provides the resin with a desirable clear quality which can be otherwise difficult to obtain with a resin of the type described above. The Perox Violet 3B may be added to either of the base or the reactor.

The resin material of the present invention is preferably made by mixing two parts of the base portion with one part of the reactor portion for approximately 2 minutes, ideally at 72°F. The mixture is then poured into a mold for curing. Only as much material that is needed to fill each mold should be made up, as the material sets very quickly. The mixture remains pourable for about 10 minutes and is generally unworkable after 15 minutes in the mixing vessel. A 0.5 inch thick slab of material poured into a tile mold is tack-free in about 4 hours and full cure is achieved in about 7 days.

In one exemplar embodiment, one foot square decorative tiles of the present invention were made, as follows. In step 1, shown in FIG. 1A, twelve ounces of the present material was made up and poured into a cavity of a tile mold to fill the mold approximately halfway, making sure all trapped air escaped out of the mixture. This first layer 10 of the material was partially cured a minimum of 6 hours and preferably a maximum of 24 hours (after which time the tile would need to be sanded first) before proceeding to step 2. Decorative elements, as described more particularly in step 2, may optionally be included in this layer.

In step 2, shown in FIG. 1B, the desired decorative elements, e.g., stones 12, pebbles, clay, rock, etc., are preferably arranged on top of the partially cured first layer 10 of material. Sixteen ounces of the present material was then made up and gently poured over the decorative elements 12, to form a second layer 14 of material, preferably being careful not to disturb the pattern of the decorative elements. The tile was further cured, preferably a minimum of 6 hours and preferably a maximum of 24 hours before proceeding to step 3.

In optional step 3, shown in FIG. 1C, twelve ounces of the material was made up and poured over the second layer as a third layer 16. Additional decorative elements 18 (sand, gravel, dye, pigment, materials, clay, powder, etc.) can be added onto the third layer or mixed into the third layer prior to pouring. Dividers or guides may be used to create a desired pattern.

These steps may be repeated as many times as desired, until the mixture is preferably even with the top of the mold and preferably with care so as not to overfill the mold.

In a second embodiment, shown in FIGS. 2 A-C, dividers or guides (not shown) are used in step 3 to create tiles having a desired striped pattern at 20 with the decorative elements. In a third embodiment, shown in FIGS. 3 A-C, the decorative elements used in step 2 (Fig. 3B) are wood strips 22, a photograph 24, and mesh 26. In a fourth embodiment, shown in FIGS. 4A-C, the decorative elements used in step 2 (Fig. 4B) are a photograph 30, wood strips 32, and stones 34 arranged in a pattern. In a fifth embodiment, shown in FIGS. 5A-C, the decorative elements used in step 2 are two photographs 40, 42, wood strips 44, and stones 46 arranged in a pattern. In a sixth embodiment, shown in FIGS. 6A-C, the decorative elements used in step 2 are two photographs 50, 52, two sets of wood strips 54, 56, and mesh 58.

Additional decorative elements may also be used, including paint, paint chips and/or pigments, paper-clips, beads, marbles, glass, mulch, glow-in-the-dark materials, and liquids. Further, the decorate element may include flowers, shells, memorabilia, shoes, clothing, dolls, figurative objects, or portions of any of the preceding.

The present invention comprises decorative and functional composite materials in the form of tiles, indoor and outdoor furniture, including beds, benches, tables, tabletops, desks, chairs, and seats and chairbacks; surfaces for work, storage, display, dividing space or standing, including bar tops, countertops, shelves, steps, walls and the like, ceilings, partition walls, dividing screens, wainscoting, baseboards, moldings, windowsills, window frames, window panels, doors, door frames, door jambs; light boxes; trays, letter openers, vases, dishes, serving platters, coasters, utensil handles, planters, lamps and other lighting fixtures, clocks, picture frames, storage devices such as shoe stands, and other utilitarian and decorative structure and items. Furthermore, purely aesthetically functional items such as sculpture forms, mosaics, and other art forms can be created with the composite material.

In each of the items made from the composite material, the composite material comprise a combination of elements embedded and/or encapsulated in an epoxy resin mixture that preferably allows the embedded and/or encapsulated elements to appear as if they are suspended or floating in space.

Items made with the materials of the present invention are thus highly decorative, are extremely durable, and may easily be made according to custom specifications. In addition, the finished tiles are solvent-free. They are waterproof; experience no shrinkage, contraction, or expansion; and are highly resistant to physical or chemical degradation. Specifically, they are resistant to mild mineral acids, alkalis, detergents, solvents, skydrol, hydraulic fluids, lubricating oils, salts, and the like.

The materials provide superior flexibility of design element selection. They are easily installed using adhesives and can easily be cleaned with either a dry or damp mop or cloth, preferably with a biodegradable cleaner. Items, particularly tiles and other planar items, made from the materials may easily be refaced and refinished by lightly sanding and filling with epoxy.

It will now be apparent to those skilled in the art that other embodiments, improvements, details and uses can be made consistent with the letter and spirit of the foregoing disclosure and within the scope of this patent, which is limited only by the following claims, construed in accordance with the patent law, including the doctrine of equivalents.